



Measuring Supply and Demand for Public Services: A Survey from Rural Sichuan, China

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ABSTRACT

The mismatch between demand and supply remains a challenge in public service delivery. A customer-oriented perspective allows us to turn our attention to the customer side of public services. Customers can also influence the performance of public services through demand and feedback. We have developed a citizen feedback framework and a public service matching model to measure the gap between supply and demand. The matching information can be fed back to public service providers to facilitate the accurate delivery of public services. We surveyed six rural communities in Sichuan, China, to test the model. We substituted data into the model and found that the matching between supply and demand for various services varied widely and was uneven across regions. The data showed that the degree of matching was positively correlated with the regional economic level. The model is valid in capturing the mismatch between supply and demand across regions and services.

Keywords: *Public Service, Demand and Supply, Matching Model, Rural Community*

1. INTRODUCTION

The pursuit of efficiency in public service has become the core of modern government management. The emphasis on improving public service capacity is a common trend in state administration today. Scholars have been concerned about the quality of public service provision [6] [9] [12]. However, the quantity of public service research has not been addressed. This potential supply-demand gap inspires this paper on the quantity of public services. It investigates the extent to which the supply and demand for public services match.

Some studies have examined the supply and demand for specific public services. They are ecosystem services [19] [16], public service facilities [2], health services [11], and environmental services [13]. These models reveal context-specific differences in service supply and demand and means of improvement. However, most studies have not considered supply and demand from the perspective of overall public services. Especially in environments where the government dominates the supply of public services, the provision of public services needs to be considered as a whole. We used the linear relationship between supply and demand to derive a matching measurement formula. A survey was conducted

among residents of six rural communities in Sichuan Province, China.

We try to explore new tools and methods and establish new concepts and frameworks to improve the efficiency and effectiveness of public service delivery. This work focuses on the quantitative matching of public service supply and demand and is constructed to compensate for the lack of directionality in public service satisfaction evaluation.

2. THEORETICAL BACKGROUND AND LITERATURE REVIEW

Two aspects cause the mismatch between the demand and supply of public services. On the supply side, first, rural governments have limited financial resources; in this case, rural governments lack sufficient resources to provide public services. Second is the lack of accountability when the government has sufficient resources but is not willing to come to provide public services. The lack of accountability may be due to deficiencies in information transmission and monitoring, which make it difficult for citizens to monitor government and make sanctioning government a challenge for citizens [1] [8]. This lack of accountability

is often associated with corruption, which can reduce the quality of public services [3] [4] [10]. On the demand side, rural China has experienced leaps and bounds in the last two decades. The needs of rural residents have increased and diversified. Therefore, to better meet the needs of rural residents, it is essential to understand how public services are now matched in rural communities.

Supply and demand are two sides of the same coin, and both sides need to be considered to provide a broader picture of public services. By doing so, public service providers can better develop support programs, for example, by identifying hot spots where public service commissioning yields the highest social benefits. Ideally, both aspects should be addressed to provide more meaningful insights from the perspective of the public service provider, but this may not always be possible due to the very high resource demands of this type of assessment [14].

The synthesis approach suggests that supply and demand for public services should be analyzed to identify mismatches between supply and demand that lead to unsustainable or ineffective management. Several frameworks exist in the literature for the integrated assessment of public service supply and demand. In the framework of ecosystem services research, supply is measured in biophysical terms, defined as “the components of an ecosystem that are provided based on biophysical properties, ecological functions and social attributes in a given area and over a given period” [19]. Some frameworks ignore the social and economic components of public service provision, such as how physical supply is influenced by policy or market responses and users’ behavior.

Demand assessment can be measured using non-monetary or economic indicators from real or hypothetical markets, such as citizens’ assessment of the importance of public services [15]. Supply-side evaluations are often related to citizens’ willingness to use public services and the management and processes that facilitate service delivery, such as amenities and soil and water conservation [20]. An overview of demand and supply involves understanding users and providers to ensure the adequate supply of public services and address the inadequate or mismatched supply; mapping, participatory methods, and modeling are often used in the integrated assessment of ecosystem service supply and demand [7].

The previous studies bring a customer-oriented perspective in dealing with market failures and support the feasibility of perception assessment in public service performance. They also reveal a gap in satisfaction research, where most evaluations are quality-oriented, and quantitative shocks remain a missing puzzle in the broader context of public service performance assessment. In addition, most studies linking citizen evaluation to performance indicators come from Western democracies

such as the United States, the United Kingdom, and Denmark, and the situation in developing countries still need to be validated. [18].

Based on the existing literature, we developed a citizen feedback system built on the demand and supply of public services. Citizens, as users of public services, are indirectly involved in the provision of public services. The public has a general demand for public services in which needs involving public sector support constitute the demand for public services. Citizens may be dissatisfied while using public services, i.e., a gap exists between the supply and demand of public services. After citizens’ perceptions of demand and supply are collected and analyzed, the gap can be calculated explicitly through a matching model. The degree of matching between demand and supply will be fed back to the provider, thus facilitating the adjustment and improvement of public service supply. Through the process of demand, adjustment, gap finding, feedback, and refinement, a balance between supply and demand is achieved, and a citizen-driven public service supply system is constructed. The citizen feedback framework is shown in Figure 1.

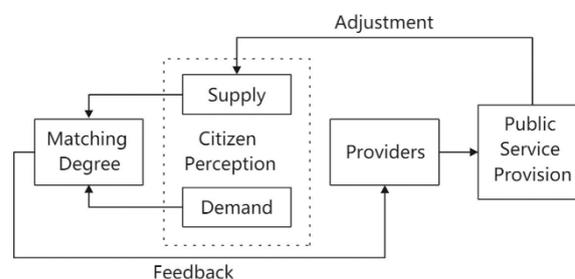


Figure 1 Citizen feedback framework based on public service demand and supply

3. DATA AND METHOD

The survey was conducted through a stratified sample. Empirical research shows that economic growth and development directly impact the provision of public services [5]. The GDP is an essential indicator of a country’s (or region’s) economic strength and can be used for international and inter-regional comparisons. Therefore, in order to highlight the differences in public service provision, we selected six urban areas by ranking the GDP values of 21 cities in Sichuan province, from those with the highest level of economic development to those with the lowest, namely Chengdu, Deyang, Liangshan, Meishan, Ya’an, and Ganzi.

Next, we selected one district and one county from each of these six jurisdictions. Then one new rural community was selected from each county by simple random sampling, yielding six rural communities, Yoan (Chengdu), Tianchi (Deyang), Jinmei (Liangshan), Yongge (Meishan), Mulin (Ya’an), and Maohe (Ganzi). The questionnaire measures the quantity of supply and demand for public services perceived by residents

separately. A total of 600 questionnaires were distributed to residents, 561 were collected, and after the manual screening, 537 were valid, with a recovery rate of 89.5%.

The elements of public service indicators for rural communities are the basis for establishing and measuring the supply-demand matching model. According to the Urban and Rural Community Service System

Construction Plan (2016-2020), jointly issued by the Ministry of Civil Affairs of China and the National Development and Reform Commission, this study classifies the public services of rural communities from the perspective of different attributes of public services, including seven categories of indicator I and 20 items of indicator II. The specific index system is shown in Table 1.

Table 1 Public service indicators for rural communities

Indicator I	Mark	Indicator II	Mark
Safety and Environmental Services	S1	Housing Safety and Security Services	S1-1
		Community Safety and Security	S1-2
		Greening and Sanitation Services	S1-3
		Public Transportation Services	S1-4
Social Welfare Services	S2	Public Education Services	S2-1
		Community Health Services	S2-2
		Social Insurance Services	S2-3
		Minimum Living Guarantee	S2-4
		Labor and Employment Services	S2-5
Agricultural Production Services	S3	Agricultural Technology Promotion	S3-1
		Agricultural Production Facilities	S3-2
		Agricultural Products Marketing Guidance	S3-3
Administrative and Legal services	S4	Administrative Services	S4-1
		Legal Services	S4-2
Information Services	S5	Public Communication Network	S5-1
		Intelligent Community Services	S5-2
Living Services	S6	Aged Care Services	S6-1
		Basic Living Services	S6-2
Leisure and Sports Services	S7	Entertainment Venues and Activities	S7-1
		Public Sports Facilities and Activities	S7-2

Descriptive statistics, ANOVA and comparative analysis are standard methods to study matching, but they are difficult to measure the degree of matching accurately and can only be used as a basis for qualitative analysis. Since the general statistical methods cannot measure the degree of matching between supply and demand of public services well, we need to find a new model. We view the supply and demand of public services as a binary relationship, where the supply and demand change is linear. From a psychological perspective, more demand for the exact matching situation increases linearly rather than in a direct additive or subtractive relationship. The amount of supply of public services perceived by citizens is necessarily in proportion to the amount of demand.

individual perceived supply and demand can be expressed as $y=ax$. When $a=1$, $y=x$, supply and demand reach equilibrium. Moreover, the cosine of the angle (θ) between the two lines $y=ax$ and $y=x$ can represent the degree of deviation between the two lines, i.e., the gap between the general matching situation and the perfect matching, which is the degree of supply and demand matching we need to calculate.

We established a coordinate system of demand (x) and supply (y), as shown in Figure 2. The points in the coordinate system (first quadrant) can represent the amount of supply and demand. The relationship between

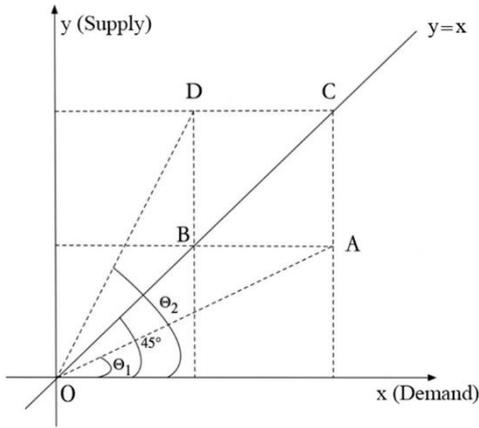


Figure 2 Demand and supply matching model for public service

The matching degree of supply and demand is expressed by α , which refers to the relationship between perceived supply and demand, as reflected in quantity. Demand and supply values are the intensity of public services perceived by residents through participation or use and are measured by resident surveys. The formula is as follows:

$$\tan \theta = x/y \tag{1}$$

$$\theta = \tan^{-1}\left(\frac{x}{y}\right) \tag{2}$$

$$\alpha = \cos(\theta - 45^\circ) \tag{3}$$

The formula for matching the supply and demand of community public services based on equation (1)(2)(3) is as follows:

$$\alpha = \cos(\tan^{-1}\left(\frac{x}{y}\right) - 45^\circ) \tag{4}$$

The value $\tan^{-1}\left(\frac{x}{y}\right) - 45^\circ$ may have negative values, while in $\cos(a)$, $a \in (0, \pi)$, the value of $\cos(a)$ cannot be calculated if a is negative, so $\tan^{-1}\left(\frac{x}{y}\right) - 45^\circ$ it needs to take absolute values. Still, by doing so, it is impossible to distinguish between undersupply and undersupply. So the sign (b), positive and negative value function is introduced, for α assigned positive and negative values. When $b > 0$, sign (b)=1; when $b=0$, sign (b)=0; when $b < 0$, sign (b)=-1. Substitute x and y into the function. When $x-$

$y > 0$, the new rural community public services are in short supply, sign ($x-y$)=1; when $x-y < 0$, there is an oversupply, sign ($x-y$)=-1; when $x-y = 0$, there is a balance between supply and demand, sign ($x-y$)=0. However, the value of α will become 0 and needs to be corrected by assigning the value of α to 1. Then the matching degree formula shows as follows:

$$\alpha = \cos(|\tan^{-1}\left(\frac{x}{y}\right) - 45^\circ|) \times \text{sign}(x - y), \tag{5}$$

$$(x \neq y)$$

$$\alpha = 1, (x = y) \tag{6}$$

Positive and negative values correspond to the matching status of undersupply and oversupply. The matching condition is positive when the supply of community public services is less than or equal to the demand.

4. RESULTS

The matching degree of indicator I and indicator II is calculated separately for each resident by the matching model. The matching levels are classified according to the frequency distribution of the matching degree, which is divided into very high (above 0.9504), high (0.9225-0.9503), average (0.8969-0.9224), low (0.8228-0.8968), and very low (below 0.8227) in indicator I. It is divided into very high (above 0.9633), high (0.9544-0.9632), average (0.8863-0.9543), low (0.8047-0.8862), and very low (below 0.8046) in indicator II.

The matching degree of the indicator I is shown in Table 2. The overall match of the sample is insufficient, with a degree of 0.8913, which is a low match. In indicator I, the degree of matching is relatively high for living services (S6 high), information services (S5 high), and safety and environmental services (S1 high). In contrast, the matching degree of social welfare services (S2 average), administrative and legal services (S4 average), agricultural production services (S3 low), and leisure and sports services (S7 very low) decrease in order.

Table 2 Matching degree of the indicator I

	General	Yoan	Tianchi	Jinmei	Yongge	Mulin	Maohe
Total	0.891	0.897	0.907	0.88	0.857	0.858	0.866
S1	0.926	0.929	0.934	0.922	0.906	0.915	0.939
S2	0.908	0.91	0.919	0.892	0.879	0.891	0.887
S3	0.837	0.845	0.859	0.814	0.791	0.761	0.755
S4	0.894	0.893	0.913	0.885	0.864	0.855	0.886
S5	0.941	0.946	0.952	0.939	0.909	0.923	0.872

S6	0.947	0.95	0.953	0.946	0.922	0.925	0.933
S7	0.787	0.808	0.819	0.763	0.727	0.734	0.791

Regionally, the impact of regional economic development on the total matching degree is significant, with the whole matching degree from highest to lowest being Tianchi (Deyang), Yoan (Chengdu), Jinmei (Liangshan), Maohe (Ganzi), Mulin (Ya'an), and Yongge (Meishan), which is consistent with the economic development level of each region. The possible reason is that areas with higher economic levels with higher resource input in public service provision. With more social and market participation, it can provide a wider variety and higher quality of public services, thus better meeting the needs of community residents. Tianchi (Deyang) has the highest supply-demand matching ratio of 0.9069. Tianchi (Deyang) has the highest supply-demand matching ratio of 0.9069. From the local community staff's point of view, it may be due to the policy of strengthening agricultural structure reform and

information technology construction proposed in Deyang in recent years, which has achieved some success.

The matches for living services (S6) and information services (S5) in Tianchi and living services (S6) in Yoan are high, at 0.9528, 0.9517, and 0.9502, respectively. In contrast, the matches for agricultural production services (S3) and leisure and sports services (S7) in Maohe, Yongge, Muling, and for leisure and sports services (S7) in Jinmei are less than 0.8, showing a much lesser matching degree.

As shown in Figure 3, the matching degree of public services varies widely among regions, and the matching degree of each indicator is generally unbalanced. From a regional perspective, the indicators of Tianchi and Yoan are relatively balanced. Still, the remaining regions have significant differences and high dispersion, with Jinmei, Maohe, Yongge, and Muling descending order of balance.

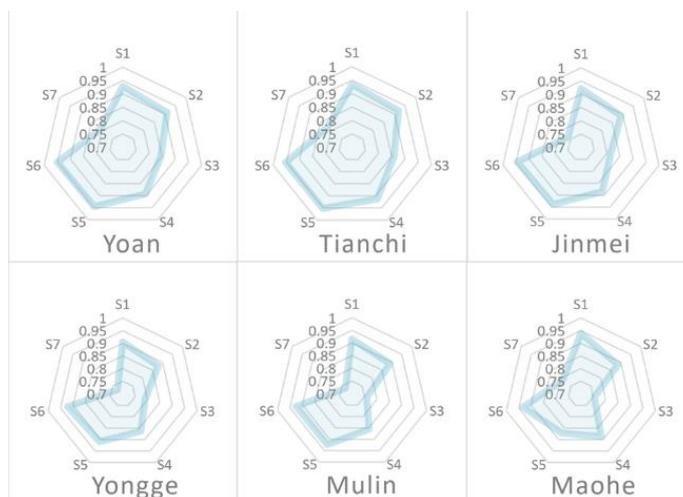


Figure 3 Balance of indicators across regions

Regarding the matching degree of indicator II, as shown in Table 3, the divergence of indicator II is more prominent than that of the indicator I. Indicator II can also clearly highlight the differences and regional imbalances in the various services. Overall, housing safety and security services (S1-1) has the highest matching degree, showing a slight oversupply with a matching degree of -0.9761. Basic living services (S6-2), public communication network (S5-1), and community safety and security (S1-2) have a high matching degree,

followed by S2-3, S1-4, S2-1, S2-4, S3-1, S6-1, S6-1 S5-2, S4-1, and S2-2, which were rated as moderate. The rest of the indicators are below average.

Community safety and security (S1-2), basic living services (S6-2) in Tianchi, and basic living services in Maohe (S6-2) have a relatively high match. Agricultural production facilities (S3-2) and agricultural marketing guidance (S3-3) in Muling are the two indicators with the lowest match, at 0.6977 and 0.6679.

Table 3 Matching degree of the indicator II

	General	Yoan	Tianchi	Jinmei	Yongge	Mulin	Maohe
S1-1	-0.9761	0.9654	-0.9758	0.9708	0.9726	-0.9859	-0.9777
S1-2	0.9558	0.9553	0.9618	0.9536	0.9361	0.9595	0.9596

S1-3	0.8193	0.8359	0.8465	0.8067	0.7829	0.77	0.843
S1-4	0.9511	0.9578	0.9536	0.9566	0.9304	0.9457	0.9563
S2-1	0.9497	0.9588	0.9518	0.949	0.9336	0.9464	0.9566
S2-2	0.9106	0.9092	0.924	0.8857	0.8856	0.8935	0.9213
S2-3	0.9538	0.9478	0.9588	0.9596	0.9345	0.9486	0.9564
S2-4	0.9497	0.9553	0.9543	0.9458	0.9332	0.9434	0.9538
S2-5	0.7765	0.7806	0.8032	0.7204	0.7061	0.7243	0.8083
S3-1	0.9418	0.9431	0.944	0.934	0.9167	0.9159	0.9457
S3-2	0.7917	0.8008	0.8167	0.7498	0.7428	0.6977	0.8164
S3-3	0.7777	0.7922	0.8072	0.7584	0.7126	0.6679	0.8143
S4-1	0.922	0.902	0.9302	0.9068	0.881	0.8872	0.9326
S4-2	0.8659	0.8842	0.8852	0.8629	0.8462	0.8236	0.8931
S5-1	0.9566	0.9553	0.9615	0.9526	0.9195	0.9305	0.9607
S5-2	0.9263	0.9365	0.9387	0.9252	0.8982	0.9163	0.9427
S6-1	0.935	0.9435	0.9411	0.934	0.9029	0.906	0.9428
S6-2	0.9579	0.9569	0.9663	0.957	0.9416	0.9439	0.9629
S7-1	0.7755	0.7915	0.7754	0.7203	0.7073	0.7139	0.8043
S7-2	0.7979	0.8251	0.8241	0.8062	0.7461	0.7532	0.8326
Note: Negative values indicate that there is an oversupply of public service.							

5. CONCLUSION

In this study, we develop a framework for citizen feedback based on the demand and supply of public services. It aims to improve public service delivery by providing feedback to suppliers on supply and demand deviations. It promotes efficient public service provision and thus counteracts market failures. Therefore, we develop a computable matching model for public service providers to measure the gap between supply and demand. The model depends on citizens' perceptions of public service supply and demand and provides a scale that can be compared across regions and services, which allows for more targeted feedback. In addition, an empirical test and analysis based on a survey of six rural communities in Sichuan, China, was conducted to examine the matching of public services in the areas above and test the feasibility and distinguishability of the model.

The overall matching degree of the sample is low, and there are significant discrepancies in the matching degree of public services in different regions and types. The matching degree is positively correlated with the economic development level. According to the interview with local communities staff, the possible reasons are: on the one hand, with the rapid development of the rural economy, people's living standards have significantly improved, and residents' needs are higher and more diversified; on the other hand, the government-led unified community living services as well as cultural and sports services are relatively basic and homogeneous.

The supply and demand match of agricultural production services (S3) and leisure and sports services (S7) in Indicator I is significantly different. Combined with indicator II, we found that the mismatch between supply and demand for agricultural production facilities (S3-2) and agricultural marketing guidance (S3-3) is relatively severe in some areas, followed by cultural and entertainment venues and activities (S7-1) and labor and employment services (S2-5). Therefore, these public services should be the priority areas for future improvement in each region. In addition, housing safety and security services (S1-1) are slightly oversupplied in some areas and should be adjusted in the future to avoid wasting resources.

5.1 Matching model validity

Concerning the matching degree of indicator II, the dispersion of the indicators is large, and the matching degree of housing safety and security services (S1-1) and agricultural marketing guidance (S3-3) in Mulin are -0.9859 0.6679, respectively, with a difference of 0.318. Thus, it shows that the matching model has high discriminatory power in regions and service categories and can effectively feedback the deviation of supply and demand of public services.

The matching degree calculated based on indicators I and II can provide some direction for the public service provision in each region. Nevertheless, sometimes, the matching degree of indicator I is ambiguous and needs to be combined with indicator II to identify the matching

deviation better. For example, the matching degree of overall social welfare services (S2) in indicator I is high at 0.9081. Still, in indicator II, the matching degree of labor and employment services (S2-5) under this category is only 0.7765, with a significant matching deviation. Therefore, the matching degree in indicator II has a critical reference value and is an essential basis for the specific improvement direction of public service provision.

In addition, the matching degree provides a prioritization perspective for public service improvement. Since there are certainly regional differences in public service inputs, it is necessary to combine the matching degree of public services to reasonably allocate funds and prioritize public service supply when the funds are limited. Based on the matching degree of indicator I, the priorities of overall public service supply in the sample should be leisure and sports services (S7), agricultural production services (S3), administrative and legal services (S4), social welfare services (S2), safety and environmental services (S1), information services (S5), and living services (S6). In this way, we can better understand the urgency of the multiple needs of the residents of rural communities and optimize the efficiency of investment in public services.

5.2 Recommendations

An evaluation system of public service matching is needed to adjust the supply of public services, effectively express residents' demands, improve their satisfaction and protect their interests. In addition, it can effectively avoid the situation where public services that consume many resources are left unattended, thus reducing the vacancy of public facilities and improving the utilization rate of social resources.

The supply of community public services should be based on the needs of residents and regions. The study above shows that the matching degree of public services varies greatly among regions, and the needs of residents in areas with different development levels are inconsistent. A one-size-fits-all public service supply will inevitably lead to a mismatch between supply and demand. Therefore, local public service agencies should improve and refine their public service supply according to the matching degree.

Developing a demand list for public services in rural communities is necessary to strengthen the citizen feedback system. The demand list is made based on the matching degree of public services. It can clarify the supply side and responsibility of public services. In addition, it provides the basis for regulating public service supply, which is the key to ensuring the subsequent perfect implementation of public service supply and improving public service matching.

5.3 Future Works

Providers' motivation to continuously improve public services remains to be further elaborated. An open and transparent public service matching survey might pressure providers to drive continuous improvement of public services. Besides, the primary purpose of our empirical study is to test the feasibility of the model, so we did not conduct a large-scale sample collection, so a larger sample will be needed in the future to achieve a more reliable supply and demand match.

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